BY ORDER OF THE
SECRETARY OF THE AIR FORCE

AIR FORCE INSTRUCTION 48-125

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Aerospace Medicine

THE US AIR FORCE PERSONNEL DOSIMETRY PROGRAM

COMPLIANCE WITH THIS PUBLICATION IS MANDATORY

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This instruction implements AFPD 48-1, *Aerospace Medicine Program* and AFPD 40-2, *Radioactive Materials (Non-Nuclear Weapons).* It defines responsibilities and procedures for conducting the US Air Force Personnel Dosimetry Program for ionizing radiation and for maintaining the USAF Master Radiation Exposure Registry (MRER). This instruction directs collecting and maintaining information subject to the Privacy Act of 1974 authorized by 10 U.S.C. 8013 and Department of Defense Instruction (DoDI) 6055.8, *Occupational Radiation Protection Program.* Systems of Records F044 AF SG O applies. This instruction applies to all Air Force military and civilian personnel occupationally exposed to ionizing radiation sources as part of their official duties as an employee of the Air Force regardless of whether or not the Air Force owns or controls those ionizing radiation sources. Send recommendations and suggested improvements on AF Form 847, **Recommendation for Change of Publication**, through channels to the Air Force Medical Operations Agency/Radiation Protection Division (AFMOA/SGOR), 110 Luke Avenue, Suite 405, Bolling AFB DC 20332-7050.

SUMMARY OF REVISIONS

This publication substantially revises AFI 48-125, *USAF Personnel Dosimetry Program, 25 July 1994*. It updates procedures for investigating over exposures and abnormal exposures to ionizing radiation, introduces new terminology, revises procedures for collecting and processing bioassay samples, implements policy for accomplishing planned special exposures, introduces guidelines to help the installation Radiation Safety Officer (RSO) evaluate the circumstances under which occupational radiation monitoring should be provided, details procedures for non-routine monitoring, for reporting of summary information, and for ensuring that radiation exposure monitoring services provided for non-Air Force personnel working in AF facilities are properly documented and results are transmitted to the individual's principal employer.

Chapter 1

USAF PERSONNEL DOSIMETRY PROGRAM

1.1. Purpose. Each person who routinely works with radioactive materials or ionizing radiation-producing machines could receive an occupational exposure to ionizing radiation. Occupational exposure includes exposures from sources external to the body (i.e., x-ray machines, various radioactive sources) and exposures from internally deposited radionuclides (i.e., ingested, inhaled or absorbed). Occupational radiation exposures do **not** include exposures to naturally occurring background radiation and or exposures received as a patient undergoing medical diagnosis or treatment. The USAF Personnel Dosimetry Program (hereafter referred to as the dosimetry program) is designed to monitor, when necessary, occupational radiation exposures. All dosimetry program monitoring results are maintained permanently in the USAF Master Radiation Exposure Registry which is maintained by the Institute for Environment, Safety, Occupational Health and Risk Assessment/Radiation Dosimetry Branch (IERA/SDRD), 2402 E. Drive, Brooks AFB, TX 78235-5001.

1.2. Program Eligibility .

1.2.1. The dosimetry program monitors all Air Force and Air National Guard military and civilian members, identified by the installation Radiation Safety Officer (RSO), as requiring personnel dosimetry per this instruction.

1.2.2. Active duty members and civilian employees of other DoD agencies:

1.2.2.1. Individuals in this category may receive personnel monitoring under terms of agreements entered into between the IERA/SDRD, Air Force Center for Radiation Dosimetry and the Radiation Dosimetry Centers of their respective DoD agencies or services.

1.2.2.2. All personnel monitoring results for individuals in this category will be stored in the USAF Master Radiation Exposure Registry (MRER) and in addition will be reported to the responsible Service or Agency dosimetry center.

1.2.3. Individuals employed by Federal, State, or Local government agencies outside the DoD may receive personnel monitoring from IERA/SDRD on a fee-for-services basis under terms of agreements entered into between IERA/SDRD and their agency radiation safety office.

Chapter 2

RESPONSIBILITIES

2.1. Deputy Assistant Secretary of the Air Force (Environment, Safety and Occupational Health)(SAF/MIQ). Provides oversight for all Air Force policy related to environment, safety and occupational health.

2.2. The Surgeon General (HQ USAF/SG). Provides policy guidance for operating the dosimetry program and ensures the program complies with Federal rules and regulations, DoD and Air Force policy, and accepted scientific practice.

2.3. Commander, Air Force Materiel Command (HQ AFMC/CC). Implements the dosimetry program through operational control of the US Air Force Center for Radiation Dosimetry (IERA/SDRD).

2.4. Commander, HQ 311th Human Systems Wing (311th HSW/CC): Provides the facilities, technical expertise and personnel for operating the US Air Force Center for Radiation Dosimetry (IERA/SDRD).

2.5. Director, Institute of Environment, Safety, Occupational Health and Risk Assessment (IERA/CC), through the US Air Force Center for Radiation Dosimetry (IERA/SDRD):

2.5.1. Establishes and maintains accreditation for the personnel dosimetry program through the National Voluntary Laboratory Accreditation Program (NVLAP), administered by the National Institute of Standards and Technology (NIST) in the following categories at a minimum:

2.5.1.1. Whole body dosimeters - Low and high-energy photons (protection and accident ranges); beta particles; neutrons; and mixtures (NVLAP performance test categories I-VIII, inclusive).

2.5.1.2. Extremity dosimeters - Low and high-energy photons; beta particles (NVLAP performance test categories I-C, II-A, III, and IV-C).

2.5.1.3. Neutron dosimeters - Neutrons and high-energy photons (NVLAP performance test categories IV and VIII).

2.5.2. Provides, processes and analyzes NVLAP accredited thermoluminescent dosimeters (TLDs) for external monitoring of personnel identified by the installation RSO as meeting criteria in Chapter 1, Paragraph **1.2.**

2.5.3. Prepares and provides reports, listings or other documentation as may be necessary to ensure installation RSO has information necessary to effectively administer the installation level program.

2.5.4. Provides on-call technical assistance to the installation RSO, or other individuals as may be appropriate, on external radiation dosimetry and program operation.

2.5.5. Ensures all dosimetry results, both internal and external, are incorporated into the USAF MRER.

2.5.6. Briefs the USAF Radioisotope Committee at its quarterly meeting on program status and statistical trends for the previous quarter.

2.5.7. Provides a written annual summary report and briefing at the 1st quarter meeting of the USAF Radioisotope Committee which details program status and statistical trends for the previous year.

2.5.8. Establishes and operates a deployable Field Laboratory for Assessing Radiation Exposure (FLARE) which provides external and internal dosimetry capability to support peacetime and wartime ionizing radiation monitoring requirements.

2.6. Director, Institute of Environment, Safety, Occupational Health and Risk Assessment (IERA/CC), through the Radioanalytical Branch (IERA/SDRR):

2.6.1. Establishes and maintains comprehensive radioanalytical capability necessary to assess potential internal deposition of radioactive material by Air Force personnel.

2.6.2. Processes and analyzes bioassay samples in accordance with scientifically established and approved analytical procedures.

2.6.3. Provides bioassay results, and any documentation necessary for their interpretation, to the requesting installation RSO and also IERA/SDRR for incorporation into the MRER.

2.6.4. Provides on-call technical support to the installation RSO or other field activities, as may be appropriate, on internal bioassay requirements and methods.

2.7. Installation Commander through the Installation RSO. Ensures occupational radiation exposure received by installation personnel is kept As Low As Reasonably Achievable (ALARA), and when required (see **Chapter 1**), is properly assessed and documented. NOTE: The installation RSO will be the Installation Bioenvironmental Engineer unless otherwise directed in writing by the Installation Commander.

2.8. Medical Treatment Facility (MTF) Commander:

2.8.1. Recommends to the installation commander that personnel be relieved from duties that could involve further radiation exposure when individuals have been or are likely to be exposed to ionizing radiation in excess of limits specified in 10 CFR 20. (Also see paragraph **8.1.**).

2.8.2. Accomplishes tests as may be necessary to medically evaluate an individual's exposure to radiation in the event of a potential over-exposure.

2.8.3. Ensures pregnant individuals working in potential occupational radiation exposure environments are referred to the Installation RSO (Bioenvionmental Engineering) for assessment and possible enrollment in the dosimetry program on a monthly monitoring frequency. NOTE: Pregnant individuals referred to the Installation RSO who are already enrolled in the dosimetry program will be placed on a monthly badge exchange frequency (see paragraph **3.2.7.**).

2.9. Bioenvironmental Engineering (BE)/Installation RSO:

2.9.1. Conducts the dosimetry program per the latest version of the USAF Personnel Dosimetry Program Manual published by IERA/SDRD and this instruction. Note: In some rare instances, program management may be assigned to other offices and individuals depending on the organizational structure and the availability of suitable radiation expertise.

2.9.2. Determines individuals and work areas meeting one or more of the monitoring conditions specified in paragraph **3.2.**

2.9.3. Determines the type of external monitoring required (i.e., body, head, extremity, beta/gamma/neutron) required, the length of the monitoring period, and the type and scope of any bioassay procedures (i.e., urine sampling, fecal sampling, etc).

2.9.4. Requests records of an individual's prior occupational radiation dose, as detailed in paragraph **3.2.** of this AFI, prior to registering an individual in the dosimetry program.

2.9.5. Briefs personnel enrolling in the dosimetry program on the following:

2.9.5.1. Proper wear and storage of TLDs and procedures for collecting any required bioassay samples.

2.9.5.2. Hazards associated with ionizing radiation and methods to keep their exposure ALARA.

2.9.5.3. (For female personnel):

2.9.5.3.1. Hazards associated with exposure to ionizing radiation during pregnancy.

2.9.5.3.2. Their responsibility to report to PH as soon as possible following confirmation of pregnancy, and the need to be placed on a monthly dosimeter exchange frequency (see paragraph **3.2.7.**).

2.9.6. Ensures Air Force personnel being monitored by other than IERA/SDRD or having bioassay samples analyzed by other than IERA/SDRR (e.g., Veterans Administration Hospital results for an Air Force radiologist, nuclear medicine technicians having positive I-131 thyroid scans, persons moonlighting in jobs involving radiation exposure) are aware of requirement to provide copies of any monitoring results, and forwards copies to IERA/SDRD for inclusion in the MRER.

2.9.7. Establishes program for monitoring visitors.

2.9.8. Reports and investigates abnormal and over exposures per this instruction (see **Chapter 7** and **Chapter 8**).

2.9.9. Requests priority processing from IERA/SDRD for dosimeters issued to pregnant workers or used in planned special exposures.

2.9.10. Maintains and reviews forms and listings received from IERA/SDRD to ensure accuracy and completeness and promptly notifies IERA/SDRD of any changes as may be appropriate.

2.10. Unit Commanders With Individuals in the USAF Personnel Dosimetry Program: Ensures the unit implements all the requirements of this instruction.

2.11. Supervisors of Individuals in the USAF Personnel Dosimetry Program:

2.11.1. Ensure badges are properly worn and handled per this instruction.

2.11.2. Refer newly assigned personnel, visitors who will enter into an area requring the wearing of radiation dosimetry, to BE for entry into the dosimetry program prior to starting work involving occupational exposure to ionizing radiation.

2.11.3. Promptly refer pregnant personnel to BE for placement into the monthly monitoring program.

2.11.4. Review the Listing 1499 and associated installation RSO comments and take whatever action might be necessary to address errors or possible adverse trends.

2.11.5. Maintain Listing 1499 and provide dosimetry results to personnel upon request. Forms are maintained until the installation RSO has distributed AF Form 1527-2 to individuals covering the same monitoring period.

2.12. Individual Participants in the USAF Personnel Dosimetry Program:

2.12.1. Provide the installation RSO with all relevant personnel dosimetry information. Such information includes, but is not limited to listing prior history of occupational radiation exposure.

2.12.2. Review dosimetry results provided by IERA/SDRD via Listing 1499, AF Form 1527-1 and(or) AF Form 1527-2 promptly upon receipt and report any errors noted to the installation RSO.

2.12.3. Comply with any requirements for bioassay sample collection.

2.12.4. Properly use issued dosimeters per instructions provided by the installation RSO and in this AFI. The Air Force may take Uniform Code of Military Justice disciplinary action against anyone who willfully engages in deliberate exposure, destruction, contamination, falsification, or tampering with dosimeters, bioassay samples, or records of dosimetry results.

Chapter 3

CONDUCTING AN INSTALLATION-LEVEL DOSIMETRY PROGRAM

3.1. General. Detailed guidance on managing installation-level dosimetry programs is contained in the latest version of the ***USAF Personnel Dosimetry Program Instruction Manual.*** Copies of this Manual may be obtained upon request from IERA/SDRD, 2402 E. Drive, Brooks AFB TX 78235-5501.

3.2. Monitoring Criteria: Eligible persons (see paragraph **1.2.**) shall be entered into the dosimetry program if any of the following apply:

3.2.1. The sum of an individual's deep dose equivalent (DDE) and internal committed effective dose equivalent (CEDE) or total effective dose equivalent (TEDE) could exceed 0.5 rem (500 milli-Roentgen Equivalent Man(mrem) or 5 milliSievert (mSv)) in a year.

3.2.2. The sum of an individual's DDE and committed dose equivalent (CDE) to any organ, other than the lens of the eye, could exceed 5 rem (5000 mrem or 50 mSv) in a year.

3.2.3. The lens dose equivalent (LDE) (i.e., dose to the eye) could exceed 1.5 rem (1500 mrem or 15 mSv) in a year.

3.2.4. An individual's shallow dose equivalent could exceed 5 rem (5000 mrem or 50 mSv) in a year to the skin or to the extremities (forearms, hands, lower legs, and feet).

3.2.5. Any adult individual likely to receive, in a year, an intake (i.e., inhale, ingest and/or absorb) in excess of 10 percent of applicable annual limits of intake (ALI). The ALIs for NRC-licensed radioactive material are in 10 CFR 20, Appendix B, Table 1, columns 1 and 2. The Surgeon General will provide, as necessary, ALIs and related air and water concentrations for radioactive material used under Air Force authority but not listed in 10 CFR 20, Appendix B.

3.2.6. The individual is younger than 18 years of age and is authorized to work within a radiation area or to handle radioactive materials, and who has the potential to receive a DDE in excess of 0.1 rem (100 mrem or 1 mSv) in a year.

3.2.7. All pregnant occupationally-exposed workers having the potential to receive DDE in excess of 0.1 rem (100 mrem or 1 mSv) over the gestation period.

3.2.8. Individuals entering a high or very high radiation area (see Terms).

3.2.9. Any individual likely to receive in the current year a cumulative radiation dose exceeding any of the limits listed above when combined with occupational dose received earlier in the same year while employed by any other employer (10 CFR 20.1201(f)).

3.2.10. Personnel monitoring may be provided to individuals not meeting any of the above criteria if the installation RSO determines the following applies:

3.2.10.1. The type of radiation to which the individual could be exposed is detectable by the personnel-monitoring program; and,

3.2.10.2. Provision of monitoring services would be helpful in demonstrating compliance with ALARA; or

3.2.10.3. Monitoring is desirable to evaluate potential exposure conditions to allay public concern.

3.2.11. Occupations Normally Not Requiring Monitoring: Monitoring is normally not required for individuals working exclusively with the following types of ionizing radiation sources.

3.2.11.1. Dental X-Ray: Experience has shown doses to personnel working with or around x-ray machines (i.e., panorex and intraoral) to be below 10 mrem per quarter. This is primarily due to the well collimated x-ray beams, positioning of the tubehead close to the patient which minimizes scatter, and adherence to good safety procedures (i.e., utilizing the principles of time, distance and shielding). Dosimetry should only be provided in the event of extenuating circumstances such as mass casualty identification duty or for purposes described in paragraphs **3.2.10.**

3.2.11.2. Baggage X-Ray: Experience has shown dose to personnel working with or around baggage x-ray units to be essentially negligible provided unit shielding and safety interlocks are functional. Dosimetry should only be provided for purposes described in paragraph 3.2.10.

3.2.11.3. Explosive Ordnance Disposal (EOD) and Office of Special Investigation (OSI) Pulsed X-Ray Units: Experience has shown doses to personnel working with or around pulsed x-ray units (non-fluoroscopic) used by EOD and OSI personnel to be negligible provided good safety procedures are followed (i.e., adherence to time, distance and shielding principles). Use of the EOD Mk-32 X-ray system does not require personnel dosimetry. Dosimetry should only be provided for purposes described in paragraph 3.2.10. NOTE: EOD and OSI occasionally will use a fluoroscopic type x-ray system. If this is the case, dosimetry may be necessary to assess exposure conditions as discussed in paragraph **3.2.**

3.3. Monitoring Period:

3.3.1. General. Personnel monitoring service is provided on a scheduled basis as determined by an evaluation conducted by the installation RSO taking into consideration factors such as prior exposure history of the unit for individuals performing similar duties, prior exposure history of the individual beginning work as an occupational radiation worker, the potential for accumulating radiation doses at a high or irregular rate, training of individuals, and other factors.

3.3.2. Normal Exchange Frequency:

3.3.2.1. Past experience indicates that most occupational radiation exposure circumstances encountered within the US Air Force can be adequately monitored by use of dosimeters exchanged on a quarterly basis. Use of quarterly monitoring periods (i.e., 3-month) generally provides greater accuracy for low dose rate environments.

3.3.2.2. Monitoring at shorter frequencies (*e.g.* monthly) is generally appropriate only under special circumstances, as detailed below.

3.3.2.2.1. Occupational radiation workers who are pregnant will be monitored on a monthly basis (see **Chapter 5**).

3.3.2.2.2. Certain operations having an exceptionally high radiation exposure potential (i.e., greater than 1.25 rem per quarter) may necessitate a monthly exchange frequency.

3.4. Determining Prior Occupational Dose:

3.4.1. The US Nuclear Regulatory Commission (NRC), in 10 CFR 20.2104, requires that individuals being enrolled in personnel monitoring programs provide information regarding their past history of occupational radiation exposure.

3.4.2. For each individual who is likely to receive, in a year, an occupational dose requiring monitoring, the installation RSO shall:

3.4.2.1. Determine the occupational internal and external radiation dose received during the current year.

3.4.2.2. Attempt to obtain the records of cumulative occupational radiation dose.

3.4.3. Prior to permitting an individual to participate in a planned special exposure, the installation RSO shall determine

3.4.3.1. The internal and external doses from all previous planned special exposures; and

3.4.3.2. All doses in excess of the limits (including doses received during accidents and emergencies) received during the lifetime of the individual.

3.4.4. In complying with the requirements of this section, the installation RSO may:

3.4.4.1. Accept, as a record of the occupational dose that the individual received during the current year, a written signed statement from the individual, or from the individual's most recent employer for work involving radiation exposure, that discloses the nature and the amount of any occupational dose that the individual may have received during the current year, or;

3.4.4.2. Accept, as the record of cumulative radiation dose, an up-to-date AF Form 1527-2 obtained from IERA/SDRD so long as the individual certifies by signature that the AF Form 1527-2 contains records of his or her complete radiation exposure history, or;

3.4.4.3. Accept, as the record of cumulative radiation dose, an up-to-date NRC Form 4, Cumulative Occupational Exposure History, or equivalent, signed by the individual and counter-signed by an appropriate official of the most recent employer for work involving radiation exposure, or the individual's current employer; and

3.4.4.4. Obtain reports of the individual's dose equivalents from the most recent employer for work involving radiation exposure or the individual's current employer by telephone, telegram, electronic media, or letter. Written verification of dose data will be requested if the authenticity of the transmitted report cannot be established.

3.4.4.5. The installation RSO, as required by this section, shall take into account an individual's prior exposure history and ensure any additional occupational radiation exposure received as a result of Air Force or concurrent moonlighting operations does not exceed allowable occupational exposure limits as specified in 10 CFR 20. Individuals whose prior exposure history exceeds allowable occupational exposure limits will not be entered into the dosimetry program. Individuals who exceed the applicable occupational exposure limit, either as a result of Air Force or concurrent moonlighting activities, will be immediately removed from all duties involving occupational radiation exposure.

3.4.5. If the installation RSO is unable to obtain a complete record of an individual's current and previously accumulated occupational dose, the installation RSO shall assume:

3.4.5.1. In establishing administrative controls for the current year, that the allowable dose limit for the individual is reduced by 1.25 rems (12.5 mSv) for each quarter for which records were unavailable and the individual was engaged in activities that could have resulted in occupational radiation exposure; and

3.4.5.2. That the individual is not available for planned special exposures.

3.5. Personnel Monitoring for Exposure to Radiation from External Radiation Sources:

3.5.1. All persons monitored by the Air Force through IERA/SDRD, or working for the Air Force but monitored by another agency, must be registered in the USAF Personnel Dosimetry Program.

3.5.2. IERA/SDRD sends dosimeters to the installation RSO or medical organization conducting the dosimetry program along with a Listing 1523 that contains information on all registered individuals.

3.5.3. At the end of each monitoring period, the installation RSO exchanges the dosimeters and ships the old dosimeters, along with the Listing 1523 for that monitoring period, to IERA/SDRD, 2402 E. Dr, Brooks AFB Texas 78235-5501. IREA/SDRD needs to receive the packages by the tenth working day of the month to facilitate processing and result reporting. Include the control dosimeters with these shipments. Ensure Listing 1523 is not mutilated in any way and all original information is legible.

3.5.4. IERA/SDRD processes all dosimeters and sends the installation RSO a Listing 1499 with the individual exposures for the monitoring period.

3.5.4.1. The installation RSO reviews the Listing 1499 and distributes a copy to the supervisors of the monitored individuals.

3.5.4.2. The installation RSO evaluates any administrative dose assigned by IERA/SDRD on the Listing 1499 due to lost or damaged dosimeters to determine the most likely dose received by the individual for the given monitoring period as follows:

3.5.4.2.1. The most likely dose will be determined by averaging the individual's dose over the last 4 monitoring periods (last 12 monitoring periods for individuals on a monthly monitoring cycle, or;

3.5.4.2.2. In the event the individual has been monitored for less than 4 periods, then the 4 monitoring period average of the highest individual in the applicable occupational code will be used.

3.5.4.2.3. The installation RSO will prepare a written memo to IERA/SDRD with the revised dose estimate. This memo should be countersigned by the individual and forwarded to IERA/SDRD. Once received, IERA/SDRD will update the MRER.

3.5.4.2.4. The installation RSO should review subsequent Listing 1499s to ensure the change has been made.

3.5.5. IERA/SDRD annually provides the installation RSO with an AF Form 1527-2 for each individual entered on the dosimetry program. The installation RSO provides these forms to each individual on the dosimetry program within 30 days following receipt. 10 CFR 19.13(c) states the installation RSO will establish a system (e.g., logbook, copy of AF Form 1527-2 signed by the individual) to document receipt of this information by the individual.

3.6. Personnel Monitoring for Exposure to Radiation from Internally Deposited Radioactive Materials.

3.6.1. All radiobioassay conducted to evaluate individual radiation exposure (radionuclide intake) shall be conducted per procedures contained in American National Standards Institute (ANSI) Standard HPS N13.30-1996 and Federal Guidance Report No.11 (EPA-520/1-88-020, 1998).

3.6.2. The installation RSO identifies personnel and work areas requiring periodic bioassay monitoring, the type of bioassay procedures the installation requires, the frequency of bioassay procedures, and the length of the monitoring period. The installation RSO coordinates all bioassay programs or collections with IERA/SDRR before implementing them.

3.6.3. At the end of the monitoring period, the installation RSO:

3.6.3.1. Retrieves and packages the bioassay sample following IERA/SDRR instructions.

3.6.3.2. Sends packaged samples, along with a completed AF Form 2753, Radiological Sampling Data, for each, to IERA/SDRR, 2402 E. Dr, Brooks AFB TX 78235-5501.

3.6.4. IERA/SDRR processes samples and sends a report to the installation RSO and to IERA/SDRD for inclusion in the MRER, Listing 1499 and AF Forms 1527-1 and 1527-2.

Chapter 4

WEARING, STORING, AND HANDLING DOSIMETERS

4.1. Wear and Handling of Dosimeters.

4.1.1. General:

4.1.1.1. Dosimeters are to be placed in the proper position on the body prior to entering a radiation area or handling radioactive materials. Dosimeters are to be removed upon leaving the radiation work place and stored in a location designated by the installation RSO.

4.1.1.2. Each dosimeter hanger is uniquely identified by means of a label provided by IERA/SDRD. If it is necessary to make any changes to this label, the original print must remain legible to properly account for the card and dosimeter.

4.1.1.3. Dosimeter holders must not be inscribed with any type of name, number or other identifying information. To ensure accurate dose assessments, dosimeter holders must not be covered with any foreign material such as duct tape, masking tape, or labels not furnished by IERA/SDRD.

4.1.1.4. Each whole body dosimeter holder has a thin mylar window designed to aid in evaluating exposures from low energy radiation. Dosimeter holders must be visually inspected before use to confirm this window is present and is intact. Dosimeter holders with missing or damaged windows are not to be used and must be returned to the installation RSO for exchange.

4.1.2. Whole Body Dosimeters. This type of dosimeter is designed to measure radiation exposure to the whole body (or major portion of the whole body). Whole Body Dosimeters are to be worn on the front of the body between the neck and the waist level on the outside of clothing. The front surface of the dosimeter faces away from the body. Normally, whole body exposures to beta, gamma, and x-radiation are assessed by use of a single whole body dosimeter.

4.1.2.1. When a lead apron or similar protective garment is used and a separate collar dosimeter is ***not*** issued (the normal circumstance), the whole body dosimeter is worn on the outside of basic clothing and outside the protective garment at neck level.

4.1.2.2. When a lead apron or similar protective garment is used and a separate collar dosimeter ***is*** issued, whole body dosimeters are worn on the outside of basic clothing but beneath the protective garment. This type of dosimeter configuration is the exception rather than the rule.

4.1.2.3. In certain situations, multiple dosimeters may be issued. These are generally used to assess localized exposures and must never be worn in lieu of the whole body dosimeter.

4.1.3. Collar Dosimeters: Under the "single badge concept" supplemental collar dosimeters are ***not normally worn***. Instead, the whole body dosimeter, worn outside of any protective shielding such as a lead apron, is used to assess the maximum dose received by an individual.

4.1.4. Supplemental Dosimeters: In specialized cases, as determined by the installation RSO, supplemental dosimeters may be worn for purposes of assessing radiation exposure beneath a shielded apron. This type of dosimeter must be worn beneath any organ shield or lead apron in addition to a whole body dosimeter worn outside any protective shielding (see 4.1.3.). The installation RSO must annotate the Listing 1523 whenever monitored individuals are issued such a supplemental dosimeter. Personnel who are issued supplemental dosimeters must also wear whole body dosimeters outside of any protective shielding.

4.1.5. Neutron Dosimeters: Specialized dosimeters issued to monitor occupational exposures to neutron radiation. Neutron and whole body dosimeters are always worn simultaneously and are worn in the same manner as whole body dosimeters. Examples of circumstances where neutron dosimeters may be required include: individuals working around medical or industrial accelerators or other sources of neutrons such as plutonium/beryllium calibration sources, Californium-252 radiography sources, nuclear reactors, nuclear weapons, etc. Accuracy of neutron dosimetry is greatly enhanced when the energy of neutron radiation to which the individual is exposed is known.

4.1.6. Extremity Dosimeters: Extremity dosimeters (most commonly finger rings) will be worn by persons determined by the installation RSO as being likely to exceed 10 percent of the applicable extremity dose limit (see paragraph **1.2.**). Dosimeters must be worn underneath any protective garments (e.g., surgical gloves and leaded gloves). Extremity dosimeters are always worn simultaneously with whole body dosimeters.

4.2. Storing Dosimeters.

4.2.1. The installation RSO designates dosimeter storage areas remote from ionizing radiation sources. The number and location of these storage areas is determined by the installation RSO, as needed to support local program needs.

4.2.2. Dosimeter storage areas must be free of oil, dust, or other contaminants.

4.2.3. Dosimeters must not be stored in areas of high temperature or moisture.

4.2.4. A designated control dosimeter must be placed in each dosimeter storage area for the entire monitoring period.

4.2.5. Dosimeters must not be stored in desk drawers, on clothing, inside vehicle glove compartments, or in places other than those approved by the installation RSO.

Chapter 5

PERSONNEL MONITORING FOR PREGNANT RADIATION WORKERS

5.1. Installation Radiation Safety Officer (RSO):

5.1.1. Evaluates the exposure potential for each pregnant worker, and advises their attending physician accordingly.

5.1.2. Prescribes protective measures to include possible enrollment in the dosimetry program (if not already on the program, and providing potential exists to exceed 100 mrem DDE over the gestation period), placement on a monthly versus quarterly dosimetry exchange cycle and priority processing of dosimetry by IERA/SDRD.

5.1.3. Recommends work restrictions necessary to ensure adequate protection of the embry/fetus. Assignment of pregnant workers to alternative duties for radiation protection purposes shall be without loss of all normal benefits associated with duties from which removed. Pregnant workers are normally removed from radiation related duties under the following circumstances:

5.1.3.1. Past monitoring (internal and external) indicates the worker will receive a whole body total effective dose equivalent of greater than 500 mrem over the gestation period, or the potential for receiving this dose is considered excessive.

5.1.3.2. Work involving unsealed radionuclides unless authorized in writing by AFMOA/SGOR.

5.1.4. The installation RSO notifies IERA/SDRD in writing of pregnant occupational radiation workers requiring monthly monitoring and priority reporting of results. This notification should be made by facsimile and must include the individual's name, Social Security Number (SSAN), the installation and work area code, the estimated date of conception, and whether or not the worker had any past history of external or internal radiation exposure.

5.2. IERA/SDRD: Monitors pregnant workers on a monthly basis and is responsible for maintaining a separate embryo/fetus dose history. Records of the dose to an embryo/fetus will be maintained with the record of dose to the mother which is reported on the AF Form 1527-1 and 1527-2. The dose history for the embryo/fetus will be kept in a sub-database of the MRER by the mother's SSAN. The embryo/fetus dose is equivalent to the sum of the mother's deep dose equivalent and internal embryo/fetus dose. Separate reporting of the embryo/fetus dose will be provided at the request of the mother.

Chapter 6

NON-ROUTINE DOSIMETRY

6.1. Monitoring of Workers on Extended Temporary Duty (TDY):

6.1.1. TDY for Periods of 90 Days or less:

6.1.1.1. Individuals going TDY for 90 days or less will take their dosimeter and a designated transit control dosimeter with them.

6.1.1.2. Upon return from TDY, the individual will ensure the dosimeter is turned in for processing at the next exchange interval. In no instances will a dosimeter be kept for periods longer than 6 months.

6.1.2. TDY for Periods Exceeding 90 Days:

6.1.2.1. TDY Locations Having an Established Dosimetry Program: While TDY to a location with an established dosimetry program, individuals will obtain necessary dosimetry at the TDY location. If dosimetry support is being provided by other than IERA/SDRD, the individual is responsible for ensuring copies of their dosimetry results are provided to IERA/SDRD for inclusion in the MRER.

6.1.2.2. TDY Locations Not Having an Established Dosimetry Program: Individuals on TDY for periods of greater than 90 days to locations without an established dosimetry program will receive dosimetry support from their sponsoring organization for the duration of the TDY assignment. Support will necessitate providing dosimetry controls and ensuring exchanges are made in a timely fashion. Gaining organizations anticipating ongoing requirements of this nature are encouraged to establish their own dosimetry programs.

6.2. Members or Employees of Other Services or Federal Agencies Who Are Occupationally Exposed to Ionizing Radiation From Air Force Operations:

6.2.1. Individuals employed by other military services or other Federal agencies may on occasion be occupationally exposed to ionizing radiation while working under Air Force jurisdiction. Examples of circumstances where this could occur include cooperative staffing of military medical treatment facilities, joint operations, etc.

6.2.2. Individuals having a primary employer other than the US Air Force who are occupationally exposed under Air Force jurisdiction (i.e., while working with radiation sources subject to licensing, permitting, or control of the Air Force) shall be enrolled in the Air Force personnel dosimetry system and shall utilize Air Force-provided personnel monitoring.

6.2.3. The Air Force Master Radiation Exposure Registry (MRER) will maintain dosimetry results for individuals in circumstances of paragraph **6.2.2.** above. In addition, dosimetry results for these individuals will be reported to the individual's primary employer using procedures established between the Air Force Center for Radiation Dosimetry and the counterpart organization in the other Federal agency.

6.2.4. The Air Force Center for Radiation Dosimetry will establish procedures for routinely requesting and obtaining dosimetry results from the US Army and US Navy personnel dosimetry centers for

any Air Force personnel who may receive personnel dosimetry services from those centers and will incorporate all such results into the MRER as doses obtained outside the Air Force.

6.3. Visitors (Occasionally-Exposed Individuals):

6.3.1. The RSO may authorize visitors to enter a radiation area or high radiation area. The installation RSO shall advise all visitors of time and distance restrictions to ensure the dose received is less than or equal to 0.01 rem. Visitors entering a radiation area may be issued a direct reading dosimeter if deemed appropriate by the installation RSO. A direct reading dosimeter shall be provided to all personnel entering a high radiation area. The decision to provide a direct reading dosimeter for entry into radiation areas should be based on the anticipated exposure potential during a single visit and the anticipated number of visits by an individual in a year. Visitors need not be provided a direct reading dosimeter if their anticipated exposure is less than 100 mrem/year. If direct reading dosimeters are issued, a log of all dosimeter readings will be maintained and include the following:

6.3.1.1. The date, time and purpose of the visit.

6.3.1.2. The visitor's printed name, SSAN, and business address and phone.

6.3.1.3. The dosimeter's serial number and calibration date.

6.3.1.4. The dosimeter reading before and after the visit.

6.3.1.5. The dosimeter's net exposure reading and net exposure time.

6.3.2. The installation RSO reviews all visitor dosimeter logs quarterly.

6.3.3. The installation RSO ensures IERA/SDRD is provided a copy of all non- zero log readings for entry into the MRER within 10 days of the end of the quarterly monitoring period.

6.3.4. When visitors enter an area where unsealed radioactive material is in use, the installation RSO shall ensure appropriate protective clothing or equipment (e.g., respiratory protection, lab coats, shoe covers, gloves, etc.) are provided as needed to keep potential doses below 0.01 rem TEDE.

6.4. Individuals Voluntarily Exposed to Radiation Sources as Subjects in Bio medical Research: Exposures of individuals to radiation as subjects in biomedical research must be approved in advance following procedures detailed in AFI 40-201.

6.5. Special Survey Dosimeters:

6.5.1. The installation RSO may request special survey dosimeters (e.g., dosimeters used for area surveys, localized exposure determinations, conducting an exposure investigation) from IERA/SDRD.

6.5.2. Dosimeters routinely provided by IERA/SDRD will not be used for special surveys unless authorized by IERA/SDRD.

6.6. Planned Special Exposures:

6.6.1. Planned special exposures will not be accomplished unless prior approval is granted by AFMOA/SGOR. Requests for planned special exposure will be signed by the installation commander and include the following:

6.6.1.1. Justification for the planned special exposure.

6.6.1.2. Radiological Work Plan to include precautions to be taken to keep exposures received ALARA.

6.6.1.3. Name, Social Security Account Numbers (SSAN), and cumulative record of lifetime radiation exposure history (NRC Form 4 or equivalent) for each individual involved.

6.6.2. Following approval by AFMOA/SGOR, the installation RSO notifies IERA/SDRD of the planned special exposure and provides individual's name, SSAN, work code and expected date of the planned exposure.

6.6.3. Upon being notified by the installation RSO, IERA/SDRD:

6.6.3.1. Ensures individuals are entered into the dosimetry program.

6.6.3.2. Provides dosimeters specifically for use during the planned special exposure.

6.6.3.3. Provides AF Form 1527-2s for individuals before and after the planned special exposure.

6.6.3.4. IERA/SDRD/SDRR provides priority processing of planned special exposure dosimeters and bioassay samples, respectively. IERA/SDRD provides consolidated external and internal results via facsimile to the installation RSO, along with a new AF Form 1527-2.

6.6.4. The installation RSO provides these results to all individuals involved in the planned special exposure within 15 days of determining the dose.6.6.3.4.

Chapter 7

ABNORMAL EXPOSURES

7.1. Abnormal Exposures. Any dosimeter and/or bioassay result exceeding any of the values in Table 7.1: Abnormal Exposure Criteria shall be considered to represent an "abnormal exposure."

Table 7.1. Abnormal Exposure Criteria.

The more restrictive of:	Monthly Dosimeter	Quarterly Dosimeter
Total Effective Dose Equivalent	≥417 mrem	≥1,250 mrem
Sum of deep dose equivalent and committed dose equivalent to any individual organ or tissue other than the lens of the eye	≥4,170 mrem	≥12,500 mrem
Eye dose equivalent	≥1,250 mrem	≥3,750 mrem
Shallow dose equivalent to skin or extremity	≥4,160 mrem	≥12,500 mrem
Internal deposition of any radionuclide	≥10% of ALI	≥25% of ALI
ALARA Constraint	≥2 S.D. above mean for all with same AFSC	

7.2. Notification. When dosimeter or bioassay processing indicates an abnormal exposure, or when a dosimeter is not returned and an administrative abnormal dose is automatically assigned, IERA/SDRD notifies the installation RSO by telephone, within 72 hours, and follows-up with a facsimile memorandum. The memorandum:

7.2.1. Identifies the dosimeter and/or bioassay sample number.

7.2.2. Includes the name, SSAN, occupational monitoring code, and Air Force Specialty Code (AFSC) of individual involved.

7.2.3. States the potential source of exposure (i.e., x-ray machine, nuclear medicine, etc).

7.2.4. Gives a dose equivalent estimate based on the dosimeter results, bioassay concentrations, or both.

7.2.5. Provides instructions for accomplishing the required investigation.

7.3. Investigation. The installation RSO initiates a formal investigation to determine:

7.3.1. Circumstances surrounding the abnormal exposure.

7.3.2. The validity of the dose received.

7.3.3. The portion of the body exposed.

7.3.4. Any corrective actions are required to prevent recurrence.

7.4. Written Report.

7.4.1. The installation RSO submits a written report on the findings of the investigation to IERA/SDRD within 30 days of being notified about the possible abnormal exposure. The report includes:

7.4.1.1. Name, SSAN, occupational dosimetry code, and AFSC of individual involved.

7.4.1.2. Description of circumstances surrounding the abnormal exposure.

7.4.1.3. Estimates of each individual's dose equivalent to include a detailed discussion of how this value was determined.

7.4.1.4. Root cause of the abnormal exposure.

7.4.1.5. Corrective actions taken to prevent recurrence.

7.4.1.6. Statement signed by the individual involved either supporting or contesting the investigation report.

7.4.1.7. Results of any medical examinations.

7.4.2. IERA/SDRD evaluates the written report and requests any additional information from the installation RSO as may be necessary to fully document the dose received, updates the MRER, and provides the installation RSO with a revised AF Form 1527-2 for the individual. IERA/SDRD retains all supporting documentation for dose assigned.

7.4.3. The installation RSO will ensure copies of reports validating the occurrence of an abnormal exposure are forwarded to AFMOA/SGOR and to the applicable Command Bioenvironmental Engineer

7.4.4. IERA/SDRD ensures the MRER is updated accordingly.

Chapter 8

OVEREXPOSURES

8.1. Potential Overexposure Identified by IERA. Any dosimeter and/or bioassay result exceeding any of the values in Table 8.2: Overexposure Criteria shall be considered to represent an "overexposure."

Table 8.1. Overexposure Criteria.

The More Restrictive Of	VALUE
Total Effective Dose Equivalent	≥5,000 mrem
Sum of deep dose equivalent and committed dose equivalent to any individual organ or tissue other than the lens of the eye	≥50,000 mrem
Eye dose equivalent	≥15,000 mrem
Shallow dose equivalent to skin or extremity	≥50,000 mrem
Internal deposition of any radionuclide	≥of applicable ALI

8.1.1. Notification:

8.1.1.1. When a dosimeter and (or) bioassay indicates an overexposure may have occurred, IERA/SDRD immediately notifies the installation RSO by telephone and follows-up with a facsimile letter within 2 hours. Facsimile copies of this letter are provided to the MAJCOM BEE and AFMOA/SGOR

8.1.1.2. Following telephone notification by IERA/SDRD, the installation RSO immediately contacts the Unit Commander and requests the individual be removed from all duties involving potential radiation exposure until an investigation of the incident can be completed. The installation RSO also notifies the MTF Commander, who in turn notifies the installation commander, as appropriate.

8.1.2. Investigation**:** The installation RSO investigates suspected overexposures in same manner as abnormal exposures (see paragraph **7.2.**). An overexposure may represent a potentially or overtly injurious dose of ionizing radiation. These investigations demand swifter action, more detailed reporting procedures, possible medical follow-up, and comprehensive documentation.

8.1.3. Written Report: The installation RSO provides a written report of the investigation findings through the MAJCOM BEE to IERA/SDRD within 7 days of being notified of the potential over exposure. Copies of this report are provided to AFMOA/SGOR. The report includes the same information as those submitted for an abnormal exposure (see paragraph **7.3.**).

8.2. Potential Overexposure Identified by the Installation.

8.2.1. An installation RSO who is notified by an individual or suspects a potential overexposure may have occurred immediately notifies IERA/SDRD and AFMOA/SGOR by telephone and follows-up with a facsimile letter explaining the circumstances.

8.2.2. Following notification by the RSO, IERA/SDRD immediately provides facsimile instructions for performing an investigation, to include any bioassay requirements, and requests the installation

RSO return any dosimeters and (or) bioassays in progress at the time immediately to IERA/SDRD for priority processing.

8.2.3. IERA/SDRR provides priority processing for all bioassay samples collected in overexposure investigations and immediately reports the results to the installation RSO by telephone and facsimile letter.

8.2.4. The installation RSO provides a written report of investigation findings to IERA/SDRD within 7 days following notification or receipt of dosimetry and (or) bioassay results whichever is later. Send copies of this report to AFMOA/SGOR.

8.3. Removal from Duties. Individuals that have possibly received an overexposure will be removed from duties involving radiation exposure pending completion of the final investigation report. This removal from duty is not to be considered adverse personnel action. If the final investigation report concludes the individual received an overexposure, AFMOA/SGOR concurrence must be obtained before the exposed individual is allowed to return to radiation related duties.

8.4. Termination of Investigation. AFMOA/SGOR evaluates the reports and either approves termination or requests additional information. Following termination, IERA/SDRD updates the MRER and provides a revised AF Form 1527-2 to the installation RSO. The installation RSO ensures the individual is given a copy of the revised AF Form 1527-2.

Chapter 9

FORMS, LISTINGS, RECORDS AND REPORTS

9.1. General:

9.1.1. In addition to standard personnel identification information, reports of personnel dosimetry results provided by IERA/SDRD include some or all of the following radiation dose values:

9.1.1.1. Dose Equivalent (rem)

9.1.1.2. Deep dose equivalent (DDE)

9.1.1.3. Lens dose equivalent (LDE)

9.1.1.4. Shallow dose equivalent (whole body) (SDEWB)

9.1.1.5. Shallow dose equivalent for maximally exposed extremity (SDEME)

9.1.1.6. Committed Effective Dose Equivalent (CEDE) (rem)

9.1.1.7. Committed Dose Equivalent for Maximally Exposed Organ (rem) (CDE)

9.1.1.8. Total Effective Dose Equivalent (rem) (DDE + CEDE)

9.1.1.9. Total Organ Dose Equivalent (rem) (DDE + CDE)

9.2. Listing 1523, Dosimetry Data. IERA/SDRD supplies this listing to the installation RSO in duplicate along with dosimeters for the next monitoring period. The installation RSO:

9.2.1. Uses this listing to enter personnel into or delete personnel from the dosimetry program, make corrections to personnel or dosimetry data following an investigation, or to show if an individual wore a lens or thyroid shield.

9.2.2. Returns the original copy of Listing 1523 to IERA/SDRD at the end of the monitoring period along with dosimeters from the previous monitoring period.

9.2.3. Retains the duplicate and compares it with the Listing 1499 for that monitoring period to insure corrections have been made.

9.3. Listing 1499, Report of Occupational Exposure to Ionizing Radiation. IERA/SDRD provides this listing (equivalent to NRC Form 5), which reports the individual's external and internal dose equivalents for the monitoring period (monthly or quarterly) and cumulative effective and organ dose equivalents for the current calendar year, to the installation RSO within 30 days following the monitoring period or upon written request. The installation RSO:

9.3.1. Reviews the Listing 1499 to ensure changes annotated on the previous Listing 1523 have been made.

9.3.2. Annotates errors in the listing or doses under investigation, signs and dates the listing and provides a copy to the applicable supervisor of the area being monitored. NOTE: This listing contains information protected under the privacy act and is to be treated accordingly.

9.3.3. Retains until compared with AF Form 1527-1. (Note: Permittees will need to retain copies of this listing with their permit information for a period of three years).

9.4. AF Form 1527-1, Annual Report of Individual Occupational Exposure to Ionizing Radiation. IERA/SDRD provides this form, which summarizes each individual's dosimetry (internal and external) dosimetry results for the calendar year, to the installation RSO. The installation RSO:

9.4.1. Reviews and compares the AF Form 1527-1 with the Listing 1499 covering the same period and reports any discrepancies to IERA/SDRD who provides a corrected form within 30 days.

9.4.2. Certifies this review by signing or signature stamping each AF Form 1527-1.

9.4.3. Makes a reasonable attempt to provide a copy of the AF Form 1527-1 to each monitored individual and establishes a system (e.g., logbook, annotation on retained copy, etc) to document each individual's receipt of the form. As a minimum, documentation should include date provided, individual's name and signature verifying receipt, and initials of installation RSO or person providing the form. The installation RSO should retain copies of AF Form 1527-1s until new forms are received. For individuals who have moved from the installation (e.g., permanent change of station, retirement, separation), one attempt will be made to send their AF Form 1527-1 to their last known forwarding address. Note: This form contains Privacy Act Information and should be treated accordingly.

9.5. AF Form 1527-2, Cumulative History of Individual Occupational Expo sure to Ionizing Radiation. IERA/SDRD provides this form (equivalent to NRC Form 4), which summarizes an individual's cumulative dosimetry history results:

9.5.1. Upon written request of the individual, installation RSO, or other authorized organizations and individuals. All requests other than those made for official Air Force use must have a release signed by the individual for whom the report is requested.

9.5.2. Prior to and following planned special exposures.

9.6. AF Form 2753, Radiological Sampling Data. The installation RSO uses this form to submit bioassay samples to IERA/SDRR for analysis. The installation RSO:

9.6.1. Prepares AF Form 2753 before submitting samples to IERA/SDRR for analysis.

9.6.2. Forwards the original copy of AF Form 2753 to IERA/SDRR with the bioassay sample, and maintains a copy until results (i.e., updated 1527-1) are received from IERA/SDRR.

9.7. NRC Form 4: The installation RSO makes a reasonable effort to collect previous dosimetry histories for individuals having either past or present non-Air Force employment. USAF personnel moonlighting in jobs where they are monitored for radiation exposure make arrangements to routinely (e.g., based on monitoring period, but no less than quarterly) provide these results to the installation RSO. The installation RSO ensures these results are forwarded to IERA/SDRD for incorporation in the MRER. The individual bears ultimate responsibility for ensuring any non-Air Force dosimetry results become part of the MRER.

9.8. Statistical Summaries of Dosimetry Results:

9.8.1. Annual Personnel Radiation Exposure Summary (RCS: HAF-SGP(A)9232):

9.8.1.1. Prior to 1 April of each calendar year, IERA/SDRD shall submit a personnel radiation exposure summary report to AFMOA/SGOR as required by AFPD 40-2, Attachment 1.

9.8.1.2. Any data that would make identification of specific individuals possible will be contained in an attachment to the report.

9.8.1.3. This report shall include the following as a minimum:

9.8.1.3.1. Zero average (all results), non-zero average (only non-zero results), and maximum annual TEDE dose for all occupational codes. Codes associated with NRC or radioactive material-related activities should be denoted for ease of reference. Results should be presented in a bar-chart format and compared to previous year and previous 5 years.

9.8.1.3.2. Zero average, non-zero average and maximum annual CEDE dose for all occupational codes. Results should be presented in bar-chart format and compared to previous year and previous 5 years. Codes associated with NRC or radioactive material-related activities should be denoted for ease of reference.

9.8.2. Special Summary Reports. IERA/SDRD will prepare additional special summary reports of dosimetry results upon request of AFMOA/SGOR. These reports may contain more detailed information than is contained in the Annual Personnel Radiation Exposure Summary. Any data that would make identification of specific individuals possible will be separated as an attachment to the main body of the report.

Chapter 10

THE USAF MASTER RADIATION EXPOSURE REGISTRY (MRER)

10.1. General. In accordance with 10 CFR 19 and 20, the Air Force is required to maintain permanent dosimetry records for all persons entered into the dosimetry program. The MRER is a computer database maintained by IERA/SDRD. The MRER provides an historical record of dose equivalent data for all persons presently or formerly registered in the program. Depending on the age of the data, some internal dosimetry results may not be on the MRER, but are instead maintained by IERA/SDRR. IERA/SDRD is the sole custodian of the MRER.

10.2. Responsibilities:

10.2.1. IERA/SDRD (The USAF Center for Radiation Dosimetry):

10.2.1.1. Permanently maintains records of all dosimetry, both internal and external, for individuals entered into the Dosimetry program.

10.2.1.2. Identifies and revises incorrect information in the registry to avoid future problems and confusion.

10.2.2. Installation RSO (Dosimetry Account Custodian). The installation RSO reviews all records associated with the dosimetry program and reports any corrections to IERA/SDRD via annotation on the Listing 1523 or via written correspondence. Correction of individual dose data in the MRER will only be made upon receipt of written request signed by the individual.

10.2.3. Individual. The individual is responsible for reviewing his/her dosimetry results and providing any corrections in writing to IERA/SDRD through the installation RSO.

10.3. Forms Prescribed. AF 1527-1, **Annual Report of Individual Exposure to Ionizing Radiation**; AF 1527-2, **Cumulative Report of Individual Exposure to Ionizing Radiation**; and AF 2753, **Bioassay Sampling Data**.

CHARLES H. ROADMAN II, Lt General, USAF, MC
Surgeon General

Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

Presidential Directive

52 FR 178:2822-2834, ***Radiation Protection Guidance to Federal Agencies for Occupational Exposure****, 24 January 1987*

Department of Defense Instruction

DoDI 6055.8, ***Occupational Radiation Protection Program,*** 6 May 1996

Air Force Publications

AFPD 40-2 - ***Radioactive Materials (Non-Nuclear Weapons)***, 8 April 1993.

AFPD 48-1 - ***Aerospace Medicine Program,*** 22 July 1993.

AFI 40-201 - ***Managing Radioactive Materials in the USAF, 25*** July 1994.

IERA Publications

USAF Personnel Dosimetry Program Instruction Manual

Applicable Codes of Federal Regulations

Title 10, Code of Federal Regulations, Parts 19 and 20

Title 29, Code of Federal Regulations, Part 1910

Selected Nuclear Regulatory Commission Regulatory Guides

8.02--Guide for Administrative Practices in Radiation Monitoring

8.04--Direct-Reading and Indirect-Reading Pocket Dosimeters

8.07-- Instructions for Recording and Reporting Occupational Radiation Exposure Data

8.09--Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program

8.10--Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable

8.13--Instruction Concerning Prenatal Radiation Exposure

8.14--Personnel Neutron Dosimeters

8.15--Acceptable Programs for Respiratory Protection

8.18--Information Relevant to Ensuring that Occupational Radiation Exposures at Medical Institutions Will Be As Low As Reasonably Achievable

8.20--Applications of Bioassay for I-125 and I-131

8.22--Bioassay at Uranium Mills

8.26--Applications of Bioassay for Fission and Activation Products

8.29--Instruction Concerning Risks from Occupational Radiation Exposure

8.32--Criteria for Establishing a Tritium Bioassay Program

8.34--Monitoring Criteria and Methods To Calculate Occupational Radiation Doses

8.35--Planned Special Exposures

8.36--Radiation Dose to the Embryo/Fetus

10.01--Compilation of Reporting Requirements for Persons Subject to NRC Regulations

Environmental Protection Agency Publication:

EPA-500/1-88-ORD – Federal Guidance Report No. 11 – ***Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion****, September 1988*

Health Physics Society (HPS) Standards:

HPS N13.11-1993 – ***Personnel Dosimetry Performance – Criteria for Testing,*** September 1993

HPS N13.32-1995 – ***Performance Testing of Extremity Dosimeters****,* August 1995

HPS N13.41-1997 **–** *Criteria* ***for Performing Multiple Dosimetry***, December 1996

HPS N13.30-1996 – ***Performance Criteria for Radiobioassay***

International Commission on Radiological Protection (ICRP) Publications:

33--Protection Against Ionizing Radiation from External Sources Used in Medicine, March 1981. (Supersedes ICRP 15 & 21).

34--Protection of the Patient in Diagnostic Radiology, May 1982. (Supersedes ICRP 16).

35--General Principles of Monitoring for Radiation Protection of Workers, May 1982. (Supersedes ICRP 12).

36--Protection Against Ionizing Radiation in the Teaching of Science, September 1982. (Supersedes ICRP 13).

41--Nonstochastic Effects of Ionizing Radiation, May 1984.

44--Protection of the Patient in Radiation Therapy, May 1984.

51--Data for Use in Protection Against External Radiation, March 1987. (Supersedes ICRP 21).

52--Protection of the Patient in Nuclear Medicine, March 1987. (Supersedes ICRP 17).

53--Radiation Dose to Patients from Radiopharmaceuticals, March, 1987,

54--Individual Monitoring for Intakes of Radionuclides by Workers: Design and Interpretation, March 1987. (Supersedes ICRP 10 & 10A)

57--Radiological Protection of the Worker in Medicine and Dentistry, October 1989.

62--Radiological Protection in Biomedical Research, (Also includes Addendum 1 to ICRP Publication 53, Radiation Dose to Patients from Radiopharmaceuticals, and a Summary of the Current ICRP Principles for Protection of the Patient in Diagnostic Radiology), May, 1993

64--Protection from Potential Exposure: A Conceptual Framework, May 1993

National Council on Radiation Protection and Measurements Reports:

32--Radiation Protection in Educational Institutions (1966)

35--Dental X-Ray Protection (1970)

36-- Radiation Protection in Veterinary Medicine (1970)

37--Precautions in the Management of Patients Who Have Received Therapeutic Amounts of Radionuclides (1970)

54--Medical Radiation Exposure of Pregnant and Potentially Pregnant Women (1977)

59--Operational Radiation Safety Program (1978)

65--Management of Persons Accidentally Contaminated with Radionuclides (1980)

68--Radiation Protection in Pediatric Radiology (1981)

69--Dosimetry of X-Ray and Gamma-Ray Beams for Radiation Therapy in the Energy Range 10 keV to 50 MeV (1981) ; 1982)

71--Operational Radiation Safety—Training (1983)

73--Protection in Nuclear Medicine and Ultrasound Diagnostic Procedures in Children (1983)

79--Neutron Contamination from Medical Electron Accelerators (1984)

80--Induction of Thyroid Cancer by Ionizing Radiation (1985)

82--SI Units in Radiation Protection and Measurements (1985)

84--General Concepts for the Dosimetry of Internally Deposited Radionuclides (1985)

87--Use of Bioassay Procedures for Assessment of Internal Radionuclide Deposition (1987)

89--Genetic Effects from Internally Deposited Radionuclides (1987)

93--Ionizing Radiation Exposure of the Population of the United States (1987)

94--Exposure of the Population in the United States and Canada from Natural Background Radiation (1988) (Supersedes NCRP Report No. 25)

95--Radiation Exposure of the U.S. Population from Consumer Products and Miscellaneous Sources (1988) (Supersedes NCRP Report No. 56)

98--Guidance on Radiation Received in Space Activities (1989)

100--Exposure of the U.S. Population from Diagnostic Medical Radiation (1989)

101--Exposure of the U.S. Population from Occupational Radiation (1989)

102--Medical X-Ray Electron Beam and Gamma-Ray Protection for Energies Up to 50 MeV (Equipment Design, Performance and Use (1989) (Supersedes NCRP Report No. 33)

104--The Relative Biological Effectiveness of Radiation of Different Quality (1990)

105--Radiation Protection for Medical and Allied Health Personnel (1989) (Supersedes NCRP Report No. 48)

107--Implementation of the Principle of As Low As Reasonably Achievable (ALARA) for Medical and Dental Personnel (1990)

114--Maintaining Radiation Protection Records (1992)

115--Risk Estimates for Radiation Protection (1993)

116--Limitation of Exposure to Ionizing Radiation (1993) (Supersedes NCRP Report No. 91)

121--Principles and Application of Collective Dose in Radiation Protection (1995)

122--Use of Personal Monitors to Estimate Effective Dose Equivalent and Effective Dose to Workers For External Exposure to Low-LET Radiation (1995)

124--Sources and Magnitude of Occupational and Public Exposures from Nuclear Medicine Procedures (1996)

National Institute of Standards and Technology (NIST) Publications:

Handbook No. 150 – ***National Voluntary Laboratory Accreditation Program – Procedures and General Requirements March 1994***

Handbook No 150-4 – ***National Voluntary Laboratory Accreditation Program – Ionizing Radiation Dosimetry, August 1994,***

Special Publication 812 – ***Criteria for the Operation of Federally-Owned Secondary Calibration Laboratories (Ionizing Radiation), October 1991***

Technical Note 1297 – Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results, September 1994

Abbreviations and Acronyms

AF—Air Force

AFI—Air Force Instruction

AFPD—Air Force Policy Directive

AFSC—Air Force Specialty Code

AFMC—Air Force Materiel Command

AFMOA/SG—Air Force Medical Operations Agency/ Environmental and Occupational Health Division

AFMOA/SGOR—Air Force Medical Operations Agency/ Radiation Protection Division

ALARA—"As Low As is Reasonably Achievable"

ANG—Air National Guard

ANSI—American National Standards Institute

BE—Bioenvironmental Engineering

Bq—Becquerel

CC—Commander

cm—centimeter (length)

cm^2—square centimeter (area)

CDE—Committed Dose Equivalent

CEDE—Committed Effective Dose Equivalent

CFR—Code of Federal Regulations

Ci—Curie

DAC—Derived Air Concentration

DLA—Defense Logistics Agency

DSWA—Defense Special Weapons Agency

DoE—The United States Department of Energy.

DoD—The United States Department of Defense

DoDI—Department of Defense Instruction

EOD—Explosive Ordinance Disposal

EPA—The United States Environmental Protection Agency

EPD—Electronic Personnel Dosimeter

HSC—Human Systems Center

HQ—Headquarters

HQ AFMC/CC—Commander, Headquarters Air Force Materiel Command

HQ USAF/SG—Headquarters, United States Air Force Surgeon General

IERA—Institute for Environment, Safety, Occupational Health Risk Assessment (formerly Det 1, HSC/OE)

IERA/SDRR—Institute for Environment, Safety, Occupational Health Risk Assessment/Radioanalytical Services Branch

IERA/SDRD—Institute for Environment, Safety, Occupational Health Risk Assessment/USAF Center for Radiation Dosimetry (formerly Det 1,HSC/SDRD)

ICRP—International Commission on Radiological Protection

mg—milligram

mrem—milli-Roentgen Equivalent Man

MRER—Master Radiation Exposure Registry

mSv—milli-Sievert

MTF—Medical Treatment Facility

MPH—Military Public Health

NVLAP—National Voluntary Laboratory Accreditation Program

NCRP—National Council on Radiation Protection and Measurements

NIST—National Institute of Standards and Technology

NRC—The United States Nuclear Regulatory Commission or its duly authorized representatives.

OSI—Office of Special Investigation

PCS—Permanent Change of Station

PDO—Publication Distribution Office

PH—Public Health

rad—Radiation Absorbed Dose

RPO—Radiation Protection Officer

rem—Roentgen Equivalent Man

RSO—Radiation Safety Officer

SG—Surgeon General

SSAN—Social Security Account Number

TDY—Temporary Duty

TEDE—Total Effective Dose Equivalent

TLD—Thermoluminescent Dosimeter

TSG—The Surgeon General

US—United States

USAF—United States Air Force

USAFR—United States Air Force Reserve

U.S.C.—United States Code

WWW—World Wide Web

Terms

Abnormal Exposure—An exposure received in any monitoring period that, if continued at the same rate, would exceed the limits specified in 10 CFR 20. Determine an abnormal exposure dose equivalent by dividing the applicable (stochastic or nonstochastic) annual limit by the number of monitoring periods during the year. For stochastic exposures, an abnormal exposure is 417 mrem (4.2 mSv) to the whole body for any monthly monitoring period and 1250 mrem (12.5 mSv) for any quarterly monitoring period**.** In addition, internal deposition of any radionuclide exceeding 10 percent ‘of the applicable ALI in one month or 25 percent of the applicable ALI in one calendar quarter is considered to be an abnormal exposure.

Absorbed dose—The energy imparted by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the rad and the gray (Gy) (1 rad = 0.01 Gy).

Act—The Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.), as amended.

activity—The rate of disintegration (transformation) or decay of radioactive material. The units of activity are the curie (Ci) and the becquerel (Bq).

administrative dose (administratively assigned dose)—An arbitrary value assigned in a dose report in cases where a dosimeter is not returned for processing at the end of the wear period, is damaged, or which cannot be evaluated due to other factors. Numerically, the values assigned are as shown in table A1.1. Administratively assigned doses must be investigated by the installation RSO as "Abnormal Exposures" following the procedure detailed in **Chapter 7** of this AFI.

Table A1.1. Administrative Dose Assigned for Lost, Damaged, or Not Returned Dosimeters.

	Monthly Dosimeter	Quarterly Dosimeter
Total Effective Dose Equivalent	417 mrem	1,250 mrem
Shallow dose equivalent to skin or extremity	4,160 mrem	12,500 mrem

Adult—An individual 18 or more years of age.

airborne radioactive material—Radioactive material dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases.

airborne radioactivity area—A room, enclosure, or area in which airborne radioactive materials, composed wholly or partly of licensed material, exist in concentrations (1) In excess of the derived air concentrations (DAC) specified in appendix B, to Secs. 20.1001-20.2401, or (2) To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

ALARA - Acronym for "As Low As is Reasonable Achievable"—Making every reasonable effort to maintain exposures to radiation as far below established dose limits as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest. Samples of good ALARA practices may be found in NRC Regulatory Guides 8.10, 8.18, 8.31, and 10.8.

Annual limit on Intake (ALI)—The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rems (0.05 Sv) or a committed dose equivalent of (H_T) 50 rems (0.5 Sv) to any individual organ or tissue. (ALI values for intake by ingestion and by inhalation of selected radionuclides are given in Table 1, Columns 1 and 2, of appendix B to Secs. 20.1001-20.2401), Title 10, Code of Federal Regulations, Part 20 (10 CFR 20).

background radiation—Radiation from cosmic sources; naturally occurring radioactive materials, including radon (except as a decay product of source or special nuclear material) and global fallout as it exists in the environment from the testing of nuclear explosive devices. "Background radiation" does not include radiation from source, byproduct, or special nuclear materials regulated by the NRC.

becquerel (Bq)—The SI unit of radioactivity equivalent to one nuclear transformation per second. One curie is 3.7×10^{10} (37 billion) Bq.

bioassay (radiobioassay)—The determination of kinds, quantities or concentrations, and, in some cases,

the locations of radioactive material in the human body, whether by direct measurement (***in vivo*** counting) or by indirect (***in vitro***) analysis and evaluation of materials excreted or removed from the human body.

byproduct material—(1) Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or utilizing special nuclear material; and (2) the tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by these solution extraction operations do not constitute "byproduct material" within this definition.

calendar quarter—A period of time of not less than 12 consecutive weeks nor more than 14 consecutive weeks. The first calendar quarter shall begin in January or begin with the dosimetry issue cycle closest to January. Subsequent calendar quarters shall begin within 12 or 14 weeks of that date so that no day is included in both quarters or omitted from a quarter.

Class (or lung class or inhalation class)—A classification scheme for inhaled material according to its rate of clearance from the pulmonary region of the lung. Materials are classified as D, W, or Y, which applies to a range of clearance half-times: for Class D (Days) of less than 10 days, for Class W (Weeks) from 10 to 100 days, and for Class Y (Years) of greater than 100 days.

collective dose—The sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation.

Commission—(See Nuclear Regulatory Commission)

Committed Dose Equivalent (CDE) ($H_{T,50}$)—The dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

Committed Effective Dose Equivalent (CEDE) ($H_{E,50}$)—The whole body dose equivalent obtained by adding the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent ($H_{E,50}$) these organs or tissues, where $H_{T,50}$ is the committed (organ) dose equivalent to an individual organ from a current uptake that will be delivered over the 50 years following the uptake. CEDE applies specifically to the dosimetry of internally deposited radionuclides.

$$\mathbf{CEDE = H_{E,50} = \Sigma W_T H_{T,50}}$$

constraint (dose constraint)—A value above which specified actions are required.

control dosimeter—A dosimeter that measures the background radiation accumulated during the transit and storage of personnel dosimeters.

controlled area—An area, outside of a restricted area but inside the site boundary, access to which can be limited by the licensee for any reason.

critical organ—That organ which will sustain the greatest absorbed dose and whose associated damage by a radionuclide entering the human body will result in greatest potential impairment to the body due to the organ's radiosensitivity.

Deep-Dose Equivalent (DDE) (H_d)—Applies to external whole-body exposure. The dose equivalent at

a tissue depth of 1 cm (1000 mg/ cm^2) beneath the outer surface of the skin.

Derived Air Concentration (DAC)—The concentration of a given radionuclide in air which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work (inhalation rate 1.2 cubic meters of air per hour), results in an intake of one ALI. DAC values are given in Table 1, Column 3, of appendix B to Secs. 20.1001-20.2401.

Derived Air Concentration-hour (DAC-hour)—The product of the concentration of radioactive material in air (expressed as a fraction or multiple of the derived air concentration for each radionuclide) and the time of exposure to that radionuclide, in hours. A licensee may take 2,000 DAC-hours to represent one ALI, equivalent to a committed effective dose equivalent of 5 rems (0.05 Sv).

dose (radiation dose)—A generic term that includes: absorbed dose, dose equivalent (H_T), effective dose equivalent (H_E), committed dose equivalent (CDE), committed effective dose equivalent (CEDE), or total effective dose equivalent (TEDE).

Dose equivalent (H_T)—The product of the absorbed dose in tissue ($\boldsymbol{D_T}$) and the quality factor ($\boldsymbol{Q}$) , and all other necessary modifying factors at the location of interest where $\boldsymbol{H_T = D_T Q}$. The units of dose equivalent are the rem and sievert (Sv) (1 rem = 0.01 sievert). The dose equivalent in Sv is equal to the absorbed dose in grays multiplied by the $\boldsymbol{Q}$; 1 Sv = 100 rems. Its purpose is to have a single unit, regardless of the type of radiation, describing the radiation effect on man. See also Deep Dose equivalent, Eye-Dose equivalent, and Shallow-Dose equivalent

dosimetry processor—An individual or organization that processes and evaluates individual monitoring equipment in order to determine the radiation dose delivered to the equipment.

dosimeter—A device that detects and measures accumulated ionizing radiation dose received by occupationally exposed individuals. The Dosimetry program uses thermoluminescent dosimeters (TLD). Examples of other types of dosimeters include film badges, pocket ionization chambers, electronic personnel dosimeters (EPD), and CR-39 fast neutron detectors.

Effective Dose Equivalent (EDE) (H_E)—The sum of the products of the dose equivalent to the organ or tissue (H_T) and the weighting factors (wT) applicable to each of the body organs or tissues that are irradiated ($H_E = \Sigma W_T H_T$). It provides a means for handling radiation situations, varying organ sensitivities, and so on and for correlating all exposures to their relative effect on the whole body.

embryo/fetus—The developing human organism from conception until the time of birth.

entrance or access point—Any location through which an individual could gain access to radiation areas or to radioactive materials. This includes entry or exit portals of sufficient size to permit human entry, irrespective of their intended use.

Exposure—Ionizing radiation may be either produced from machines (x-ray machines, accelerators, etc.) or spontaneously emitted by radioactive material. An individual located near such machines or materials may be "exposed" to the ionizing radiation emitted therefrom; hence, sustain an exposure.

external dose—The portion of the dose equivalent received from radiation sources or devices outside the body.

external Emitter—A radionuclide or ionizing radiation producing device which is located external to the body.

Extremity—The hand, elbow, arm below the elbow, foot, knee, or leg below the knee

Generally applicable environmental radiation standards—Standards issued by the EPA under the authority of the Atomic Energy Act of 1954, as amended, that impose limits on radiation exposures or levels, or concentrations or quantities of radioactive material, in the general environment outside the boundaries of locations under the control of persons possessing or using radioactive material.

government agency—Any executive department, commission, independent establishment, corporation wholly or partly owned by the United States of America, which is an instrumentality of the United States, or any board, bureau, division, service, office, officer, authority, administration, or other establishment in the executive branch of the Government.

Gray—Unit of absorbed dose; equivalent to 100 rads.

high radiation area—An area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

Individual—A human being.

individual monitoring—(1) The assessment of dose equivalent by the use of devices designed to be worn by an individual; (2) The assessment of committed effective dose equivalent by bioassay (see Bioassay) or by determination of the time-weighted air concentrations to which an individual has been exposed, i.e., DAC-hours; or (3) The assessment of dose equivalent by the use of survey data.

individual monitoring devices (individual monitoring equipment)—Devices designed to be worn by a single individual for the assessment of dose equivalent such as film badges, thermoluminescent dosimeters (TLDs), pocket ionization chambers, and personal (‘‘lapel’’) air sampling devices.

internal dose—That portion of the dose equivalent received from radioactive material taken into the body.

Intake—The amount of radioactive material taken into the body by inhalation, absorption through the skin, injection, ingestion, or through wounds.

internal dose—The portion of the dose equivalent received from radioactive material taken into the body.

internal emitter—A radionuclide that is deposited in the body.

investigation level—(a) A dose equivalent value or radionuclide intake activity set by the installation RSO that requires further investigation when exceeded. Levels are normally tailored to each using section’s historical dosimetry data in order to promptly identify and correct adverse trends; (b) The CEDE from radioactive material taken into the human body or dose equivalent from an external radiation source to which the worker is occupationally exposed which justifies further investigation. Such an investigation generally includes a review of the circumstances associated with the apparently abnormal internal or external personnel dose equivalent, assessment of the consequences, and mitigation or prevention of such a personnel dose equivalent of similar magnitude in the future.

ionizing radiation—Any electromagnetic or particulate radiation capable of producing ions, directly or indirectly in its passage through matter. Ionizing radiation includes gamma rays, X rays, alpha particles, beta particles, neutrons, protons, and other particles and electromagnetic waves capable of producing ions.

lens-dose equivalent (H_E)(LDE)—The dose equivalent to the lens of the eye from external exposure of the lens of the eye to some ionizing radiation source. It is measured at an eye lens tissue depth of 0.3 cm (300 mg/cm^2).

License—A license issued under the regulations in parts 30 through 36, 39, 40, 50, 60, 61, 70, or 72 of the NRC.

licensed material—Source material, special nuclear material, or byproduct material received, possessed, used, transferred or disposed of under a general or specific license issued by the Commission.

Licensee—The holder of a license.

limits (dose limits)—The permissible upper bounds of radiation doses.

lost or missing licensed material—Licensed material whose location is unknown. It includes material that has been shipped but has not reached its destination and whose location cannot be readily traced in the transportation system.

Master Radiation Exposure Registry (MRER)—The USAF's sole permanent record keeping registry of occupational ionizing radiation exposures for all personnel (past and present) enrolled in the Dosimetry program. The US Air Force Center for Radiation Dosimetry maintains the MRER.

member of the public—Any individual except when that individual is receiving an occupational dose.

Minor—An individual less than 18 years of age.

monitoring (radiation monitoring, radiation protection monitoring)—The measurement of radiation levels, concentrations, surface area concentrations or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses.

National Voluntary Laboratory Accreditation Program (NVLAP)—A program administered by the National Institute of Standards and Technology (NIST) for the accreditation of ionizing radiation dosimetry processing laboratories. Accreditation is based on three rounds of open blind performance testing and site visits conducted by NVLAP National Technical Experts and is repeated every two years. Separate standards applicable to whole body and extremity dosimetry are detailed in NIST Handbook 150, NIST Handbook 150-4, and standards published by the Health Physics Society.

nonstochastic effects—Health effects, the severity of which varies with the dose and for which a threshold is believed to exist. Radiation-induced cataract formation is an example of a nonstochastic effect (also called a deterministic effect).

Occasionally- exposed individual—An individual whose work is not normally performed in a restricted area and whose duties do not normally involve exposure to ionizing radiation or radioactive material. Such individuals may, however, have reason to enter a restricted area in the performance of their duties. Examples are messengers, deliverymen, and maintenance workers.

occupational dose—The dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to radiation and/or radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee or other person. Occupational dose does not include doses received from background radiation, from any medical administration the individual has received, from voluntary participation in medical research programs, or as a member of the public.

occupationally-exposed individual—Any individual who receives an occupational dose of radiation as a

result of employment in an occupation involving the use of radioactive material or equipment capable of producing ionizing radiation.

overexposure (quarterly or annual)—Any accumulated or one-time ionizing radiation exposure exceeding the limits specified in 10 CFR.

Permit—A written authorization to possess and use radiation sources issued by AFMOA/SGOR under the provisions of NRC Air Force Master Material License.

Person—Any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the NRC or the DoE subject to the licensing and related regulatory authority of the NRC and/or the Air Force Master Material License.

planned special exposure (PSE)—An exposure that occurs infrequently during normal operations when it is necessary to permit a worker to receive doses in excess of the annual dose equivalent limits. Evaluate dose-limiting provisions for planned special exposures separately from and in addition to the dose-limiting conditions for normal exposure conditions. AFMOA/SGOR must approve all planned special exposures beforehand.

public dose—The dose received by a member of the public from exposure to radiation and/or radioactive material released by a licensee, or to any other source of radiation under the control of the licensee. Public dose does not include occupational dose or doses received from background radiation, from any medical administration the individual has received, or from voluntary participation in medical research programs.

Quality Factor (Q)—The modifying factor shown in Table A1.2. that is used to derive dose equivalent from absorbed dose.

If it is more convenient to measure the neutron fluence rate than to determine the neutron dose equivalent rate in rems per hour or sieverts per hour, as provided in paragraph (b) of this section, 1 rem (0.01 Sv) of neutron radiation of unknown energies may, for purposes of the regulations in this part, be assumed to result from a total fluence of 25 million neutrons per square centimeter incident upon the body. If sufficient information exists to estimate the approximate energy distribution of the neutrons, the licensee may use the fluence rate per unit dose equivalent or the appropriate Q value from Table A1.3. to convert a measured tissue dose in rads to dose equivalent in rems.

Table A1.2. Radiation Quality Factors.

Type of Radiation	*Quality Factor(Q)*	*Absorbed dose equal to* a unit dose equivalent[a]
X-, gamma, or beta	1	1
Alpha particles, multiple-charged particles, fission fragments and heavy particles of unknown charge	20	0.05
Neutrons of unknown energy	10	0.1
High-energy protons	10	0.1
[a] Absorbed dose in rad equal to 1 rem or the absorbed dose in gray equal to 1 sievert.		

Table A1.3. Neutron Quality Factors.

Neutron Energy (MeV)	Quality Factora(Q)	Fluence per unitDose equivalentb(neutrons cm^{-2} rem^{-1}
(Thermal) 2.5×10^{-8}	2	980×10^{6}
1×10^{-7}	2	980×10^{6}
1×10^{-6}	2	810×10^{6}
1×10^{-5}	2	810×10^{6}
1×10^{-4}	2	840×10^{6}
1×10^{-3}	2	980×10^{6}
1×10^{-2}	2.5	1010×10^{6}
1×10^{-1}	7.5	170×10^{6}
5×10^{-1}	11	39×10^{6}
1	11	27×10^{6}
2.5	9	29×10^{6}
5	8	23×10^{6}
7	7	24×10^{6}
10	6.5	24×10^{6}
14	7.5	17×10^{6}
20	8	16×10^{6}
40	7	14×10^{6}
60	5.5	16×10^{6}
1 X 102	4	20×10^{6}
2 X 102	3.5	19×10^{6}
3 X 102	3.5	16×10^{6}
4 X 102	3.5	14×10^{6}

[a] Value of quality factor (Q) at the point where the dose equivalent is maximum in a 30-cm diameter cylinder tissue-equivalent phantom.

[b] Monoenergetic neutrons incident normally on a 30-cm diameter cylinder tissue-equivalent phantom.

Quarter—A period of time equal to one-fourth of the year observed by the licensee (approximately 13 consecutive weeks), providing that the beginning of the first quarter in a year coincides with the starting date of the year and that no day is omitted or duplicated in consecutive quarters.

Radiation Absorbed Dose or Rad—The special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs/gram or 0.01 joule/kilogram (0.01 gray).

radiation (ionizing radiation)—Alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high- speed protons, and other particles capable of producing ions. Radiation, as used in this part, does not include non-ionizing radiation, such as radio- or microwaves, or visible, infrared, or ultraviolet light.

radiation area—An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 mSv) in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.

radiation monitoring--Evaluating—or measuring radiation levels and amounts or concentrations of radionuclides in air, water, or other materials, to evaluate potential exposures and doses to personnel.

Radiation Safety Officer (RSO)—An individual, normally a Health Physicist, Bioenvironmental Engineer, Department of the Air Force civilian, or a qualified Bioenvironmental Engineering Craftsman, designated in writing by the installation commander to manage the radiation safety program for the installation or using activity. This person may or may not be the RSO responsible for activities conducted under a given USAF Radioactive Materials Permit. (Also referred to as Radiation Protection Officer (RPO)

radiation sources—Material, equipment, or devices which spontaneously generate or are capable of generating ionizing radiation. Examples include- nuclear reactors, medical and dental radiographic and fluoroscopic x-ray systems, particle generators and accelerators, certain electromagnetic generators operating at electrical potentials that result in the production of X rays, X-ray diffraction, industrial radiographic, and spectrographic equipment, electron microscopes, electron-beam welding, melting, and cutting equipment, nuclear moisture or density gauges, byproduct, source, and special nuclear materials, natural or accelerator-produced radioactive materials, materials containing induced or deposited radioactivity, and radioactive commodities.

Radionuclide—A radioactive species of atom characterized by its mass number (A), atomic number (Z), and nuclear energy state, provided that the mean life of that state is long enough to be observable.

reference man—A hypothetical aggregation of human physical and physiological characteristics arrived at by international consensus. These characteristics may be used by researchers and public health workers to standardize results of experiments and to relate biological insult to a common base.

Roentgen Equivalent Man or rem—The special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor (1 rem = 0.01 sievert) (1 rem = 1,000 millirem)

respiratory protective device—An apparatus, such as a respirator, used to reduce the individual's intake

of airborne radioactive materials.

restricted area—An area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

shallow-dose equivalent (H_s)—The external exposure of the skin or an extremity which is taken as the dose equivalent at a tissue depth of 0.007 cm (7 mg/cm^2—average depth of the germinal cell layer) averaged over an area of 1 cm^2.

sanitary sewerage—A system of public sewers for carrying off waste water and refuse, but excluding sewage treatment facilities, septic tanks, and leach fields owned or operated by the licensee or permute.

sievert (Sv)—The SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv = 100 rems). One millisievert (mSv) is 0.001 Sv (0.1 rem) (100 mrem)

site boundary—That line beyond which the land or property is not owned, leased, or otherwise controlled by the licensee.

source material—Uranium or thorium, or any combination of uranium or thorium in any physical or chemical form; or Ores which contain by weight one-twentieth of 1 percent (0.05 percent) or more of uranium, thorium, or any combination of uranium and thorium. Source material does not include special nuclear material.

Special nuclear material (SNM)—Plutonium, uranium-233, uranium enriched in the isotope 233 or in the isotope 235. Any other material the NRC determines to be special nuclear material as defined by 10 CFR 20 and(or) 10 CFR 70. Special nuclear material does not include source material.

stochastic effects—Health effects which occur randomly and for which the probability of the effect occurring, rather than its severity, is assumed to be a linear function of dose without threshold. Hereditary effects and cancer incidence are examples of stochastic effects.

Survey—An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other sources of radiation. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

Termination—The end of employment with AF and ANG involving personnel radiation monitoring.

thermoluminescent dosimeter (TLD)—A type of dosimeter that uses powdered or solid phosphor materials (e.g., $Li_2B_4O_7$, LiF, $CaSO_4$) to record radiation exposures. When heated, the phosphor emits light proportional to the amount of radiation energy absorbed. This type of dosimeter consists of a card and a holder (badge).

total effective dose equivalent (TEDE)—The sum of the deep dose equivalent (H_d) (for external exposures) and the committed effective dose equivalent (for internal exposures), expressed in units of either rems or Sv.

unrestricted area—An area, access to which is neither limited nor controlled for purposes of radiation

protection.

User—An individual who has been delegated the authority for the use, operation, or storage of radiation sources and devices.

uranium fuel cycle—The operations of milling of uranium ore, chemical conversion of uranium, isotopic enrichment of uranium, fabrication of uranium fuel, generation of electricity by a light-water-cooled nuclear power plant using uranium fuel, and reprocessing of spent uranium fuel to the extent that these activities directly support the production of electrical power for public use. Uranium fuel cycle does not include mining operations, operations at waste disposal sites, transportation of radioactive material in support of these operations, and the reuse of recovered non-uranium special nuclear and byproduct materials from the cycle.

very high radiation area—An area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in 1 hour at 1 meter from a radiation source or from any surface that the radiation penetrates. (Note- For very high doses received at high dose rates, units of absorbed dose (e.g., rads and grays) are appropriate, rather than units of dose equivalent (e.g., rems and sieverts)).

Visitor—A person who does not normally work in an USAF controlled radiation area, but who may be authorized to enter the area by the installation RSO providing suitable dosimetry and/or protective equipment is available.

Week—Seven consecutive days starting on Sunday.

weighting factor w_T, for an organ or tissue ($_T$)—The proportion of the risk of stochastic effects resulting from irradiation of that organ or tissue to the total risk of stochastic effects when the whole body is irradiated uniformly. For calculating the effective dose equivalent, the values of w_T are shown in Table A1.4.

Table A1.4. Organ Dose Weighting Factors.

Organ or Tissue	w_T
Gonads	0.25
Breast	0.15
Red bone marrow	0.12
Lung	0.12
Thyroid	0.03
Bone Surfaces	0.03
Remainder	0.301
Whole Body	1.002

[1]0.30 results from 0.06 for each of 5 ‘‘remainder” organs (excluding the skin and the lens of the eye) that receive the highest doses.

[2] For the purpose of weighting the external whole body dose (for adding it to the internal dose), a single weighting factor, w_T=1.0, has been specified. The use of other weighting factors for external exposure will be approved on a case-by-case basis until such time as specific guidance is issued.

whole body—For purposes of external exposure, the head, trunk (including male gonads), arms above the elbow, or legs above the knee.

Year—The period of time beginning in January used to determine compliance with the provisions of this part. The licensee may change the starting date of the year used to determine compliance by the licensee provided that the change is made at the beginning of the year and that no day is omitted or duplicated in consecutive years.